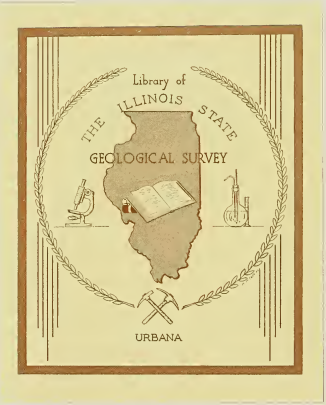

STATE OF ILLINOIS
ADLAI E. STEVENSON, *Governor*
DEPARTMENT OF REGISTRATION AND EDUCATION
NOBLE J. PUFFER, *Director*

DIVISION OF THE
STATE GEOLOGICAL SURVEY
M. M. LEIGHTON, *Chief*
URBANA

CIRCULAR NO. 166

MINERAL RESOURCE RESEARCH AND ACTIVITIES OF THE STATE GEOLOGICAL SURVEY, 1948-1949

BY

M. M. LEIGHTON, *Chief*

Reprinted from the Annual Report of the Chief to the Director,
Department of Registration and Education,
for Fiscal Year 1948-1949

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URBANA, ILLINOIS
1950

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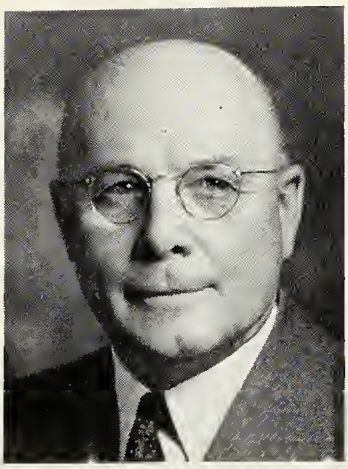
THE NATURAL RESOURCES BUILDING, on the University of Illinois campus, houses the offices and laboratories of the Geological Survey and the Natural History Survey Divisions of the Department of Registration and Education.



Dr. M. M. Leighton

ILLINOIS STATE GEOLOGICAL SURVEY

M. M. Leighton, Chief

Illinois' mineral production in 1948, valued at more than half a billion dollars, included the following:

Coal	$242,171,000
Oil and gas	195,000,000
Clay and clay products	43,446,181
Limestone and dolomite	21,974,526
Cement	7,000,000
Fluorspar	6,322,246
Silica sand	4,766,939
Gravel	5,188,648
Zinc and lead	3,000,000
Lime	2,958,771
Other sand	4,026,129
Ground silica	1,482,530
Mineral wool, Other minerals	150,000
	$537,486,970

Added to these were the minerals that were processed in Illinois but mostly mined elsewhere. They include pig iron, coke and by products, slab zinc, sulfuric acid, and others. Separate figures are not available, but their combined total value for 1948 is estimated at $246,000,000.

Objective and Organization

Since its establishment in 1905, the Illinois Geological Survey has been studying and developing information of wide scope on the mineral

resources of the State. Close contact is maintained with industries in order to keep abreast of their modern technological developments and their needs. Through letters and personal conferences, and its many publications, the Survey provides accurate scientific information on the State's mineral materials and products to land owners, producers, manufacturers, consumers, and interested citizens.

In 1948 its scientific and technical staff included 42 geologists, 21 chemists, 6 engineers, a mineral economist, a physicist, an editor, a specially trained librarian, and more than 25 college-trained assistants.

Financial Statement

The following is a statement of funds available and expenditures for the fiscal year beginning July 1, 1948 and ending June 30, 1949.

Appropriation Item	Funds Available —2nd Year	Expenditures to June 30, 1949	Encumbrances	Lapsed Balance
Personal Services, Regular	455,531	434,213	.....	21,318
Personal Services, Extra Help	13,144	12,092	.....	1,052
Contractual Services	11,813	10,084	1,729	.....
Office Expenses	1,963	1,709	254	.....
Travel	20,641	17,456	2,868	317
Commodities	31,376	26,758	4,618	.....
Equipment	48,859	38,877	9,161	822
Emp. Contribution to University Retirement System of Illinois	5,926	5,926	.....	.....
Topographic Surveys	37,887	26,999	10,888	.....
	627,140	574,114	29,518	23,509
Printing	29,165	29,755	266	-857
Postage	1,875	1,875	.....	.....

Cash Receipts to State Treasurer, July 1, 1948 to June 30, 1949 ..... $3,975.86

The expenditures through June 30, 1949 were distributed among the following activities:

Coal	$ 93,130
Oil and Gas	41,924
Industrial Minerals	31,461
Clay Resources and Clay Mineral Technology	15,925
Fluorspar	9,022
Ground-Water Geology and Geophysical Exploration	37,304
Engineering Geology and Topographic Surveys	33,659
Subsurface Geology	43,079
Areal Geology and Paleontology	13,475
Mineral Economics	13,281
Physics	11,554
Geochem. Administration, etc.	21,776

X-ray	5,778
Analytical Chemistry	32,440
Educational Extension	10,215
Mineral Resources Records	16,900
Publications	16,133
Public service (clerical, information office, mail distribution)	36,206
Geological Resources Administration	9,338
General Administration (Chief's office, financial records, motor cars, etc.)	81,514
	$ 574,114

Research Activities

Coal

More than 66 million tons of coal were produced in Illinois during 1948, an amount within 3 per cent of the 1947 production which was the highest in the State's history. Outstanding among new mining operations in the State in the past year are large strip and slope mines in Vermilion and Williamson counties. During the year, some seven mines in St. Clair, Christian, LaSalle, Washington, and Schuyler counties were abandoned.

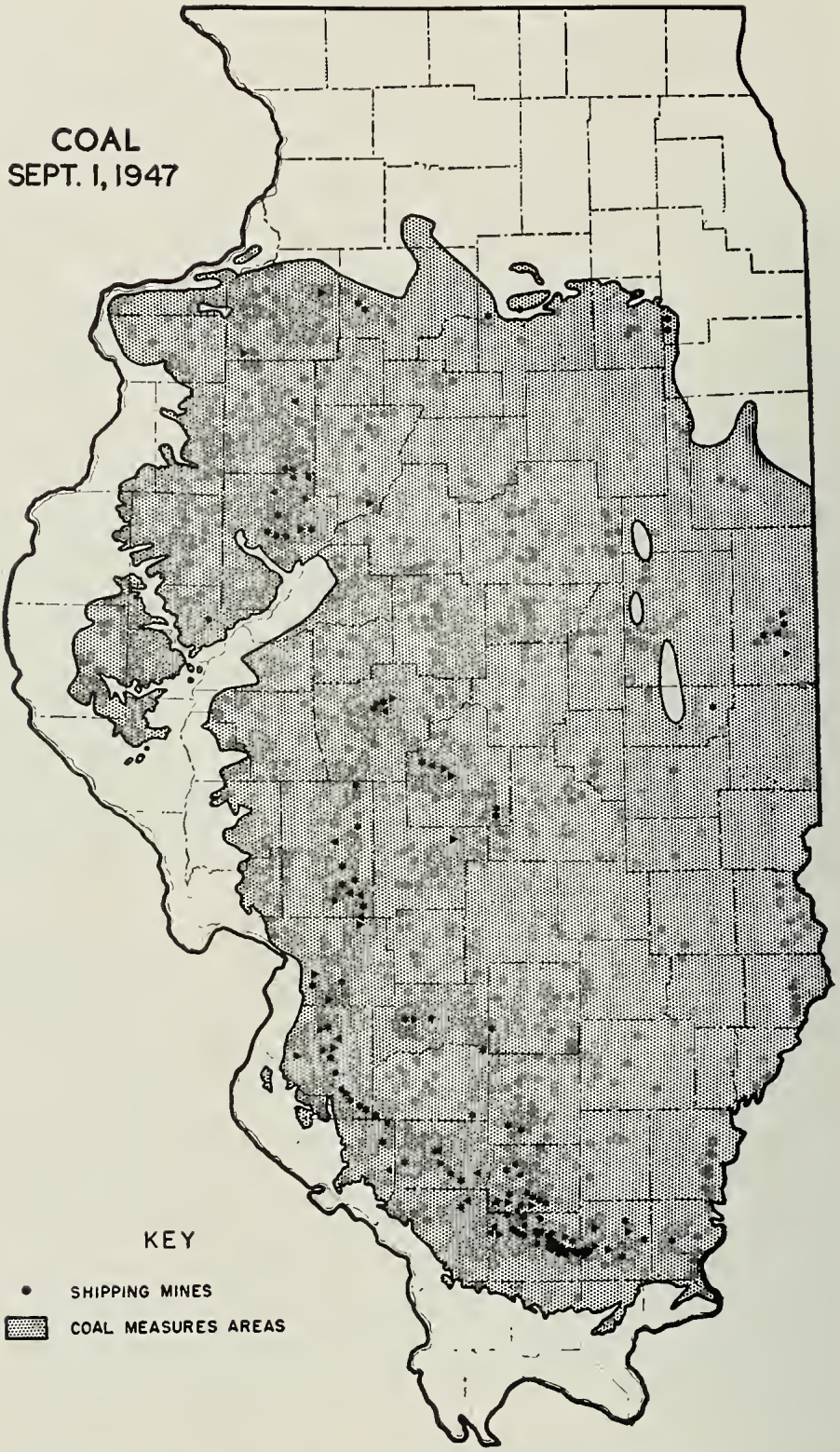
1) *Additional deposits of coal,* minable at a profit under present conditions, must be located if production is to keep pace with continuing high demand. The State Geological Survey aids unstintingly in this search for new coal by assembling records from widespread drilling activity in the State, evaluating areas for prospecting, and interpreting the results of diamond drill tests carried on by the operators to delineate areas favorable for future operations.

2) *The classification, mapping, and interpretation of new information* on the coal resources of the State is a long-standing never-ending task. All new data—geological, engineering, or chemical—must be evaluated, classified, tabulated, geographically and geologically mapped, and studied and interpreted for the use of all who may be interested.

During the past year a map of the No. 6 coal and tabulation of data have been completed for Marion County and adjacent parts of bordering counties. Maps and reports are also in progress on the subsurface structure in Wabash and White counties, and maps are being prepared on the structure and coal resources of the No. 6 and No. 7 coal beds in Vermilion County. A report on Jasper County has been completed.

Diamond-drill cores totalling more than 21,000 feet were logged and recorded from 78 drill holes in Edgar, Jackson, Macoupin, and Williamson counties and drill cuttings from 13 holes in Moultrie County have been studied. Coal stripping conditions and operations were investigated in Gallatin, Saline, Williamson, Jackson, Randolph, and St. Clair counties.

3) *A new multi-million dollar market for Illinois coal* has resulted from the State Geological Survey's research on the use of Illinois coal in blends with Appalachian coals in the manufacture of metallurgical coke,



More than half of Illinois is underlain by the Coal Measures. Dots show locations of shipping coal mines as of 1947.

necessary for the production of pig iron and steel. This investigation was begun in 1943. A pilot oven of 500-pounds coal capacity, designed and built by members of the Survey staff, proved to be trustworthy in reproducing the coke products of large commercial ovens and surprisingly economical in obtaining data for steel companies. Their enthusiastic cooperation in the experimental use of Illinois coal has resulted in the development of a market for more than 1 million tons of Illinois coal per year.

During the current year, coals from 25 different Illinois mines have been carbonized in the Survey oven during the period of its operation. A by-product recovery train makes possible the collection and evaluation of tar and gas products.

The experimental oven itself has attracted wide attention. Four others have now been built according to the Survey's design, in Pittsburgh, Chicago, Concepciòn in Chile, and at Pretoria in South Africa and blue-print plans have been furnished to England and to Japan.

4) *The preparation of char from Illinois coals* for experimental use as a substitute for Pocahontas coal in metallurgical coke blends has become a companion project to the coal-blending studies described above. Pilot plant equipment has been designed and built, and a few experimental runs have been made to develop procedures and "season" the equipment. Coals from the various mining districts of Illinois will be processed and a thorough study will be made of the nature, properties, and potentialities of char from these coals.

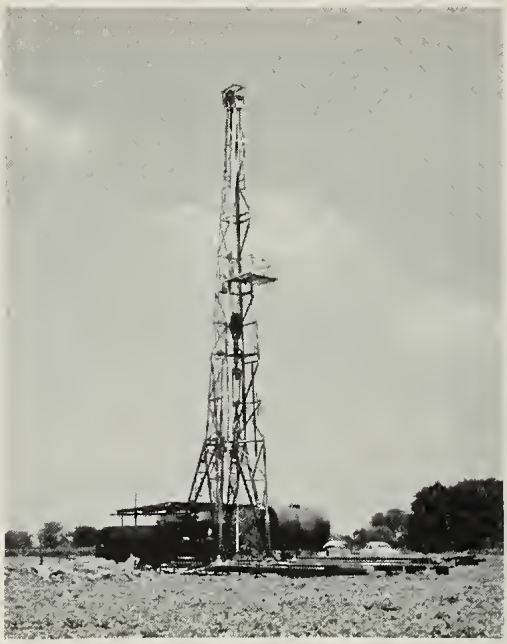
5) *Better fuel for domestic stokers* should result from the Survey's investigations of stoker coals. Previous Survey studies have demonstrated the relationships between the combustion characteristics of coal and its chemical and physical composition, as well as the effect of coal-size upon combustion characteristics, valuable to manufacturers in improving the design and operation of stokers. During the past year tests were conducted on coals from Bureau, Jackson, Randolph, and St. Clair counties, Illinois, and from elsewhere, to correlate stoker performance with types of coal and laboratory determinations. A comprehensive report on the results is being prepared.

Particular attention is now being given to the design and erection of a standard stoker boiler set-up. This "standard" unit is a result of the joint efforts of Bituminous Coal Research, The Stoker Manufacturers Association, and the Illinois Survey, in order to develop a standard method of testing stoker coals.

6) *The chemical and physical characteristics of coal* as a chemical substance continue to receive fundamental study in order to gain new light on its chemical nature and structure, to extend the use of coal as a chemical raw material, and to improve present methods of storage, preparation, and use.

7) *Fossil plant spores* contained in Illinois coal have been found to be a valuable guide in the correlation of coal beds. These tiny "seeds," millions of years old, can be observed only through the microscope under special laboratory techniques but they unlock doors for the coal operators in identifying the various coal seams as they explore for new resources.

8) *Another potentially useful tool* in correlation studies is the presence, in minute amounts, of other minerals. Thin-sections of drill-hole cores are cut and polished and studied under the petrographic microscope. During the past year, cores from 13 drill holes in Edgar, Macoupin, and Williamson counties have been so studied, and 85 thin-sections from cores in Wabash and Williamson counties have been prepared and examined.



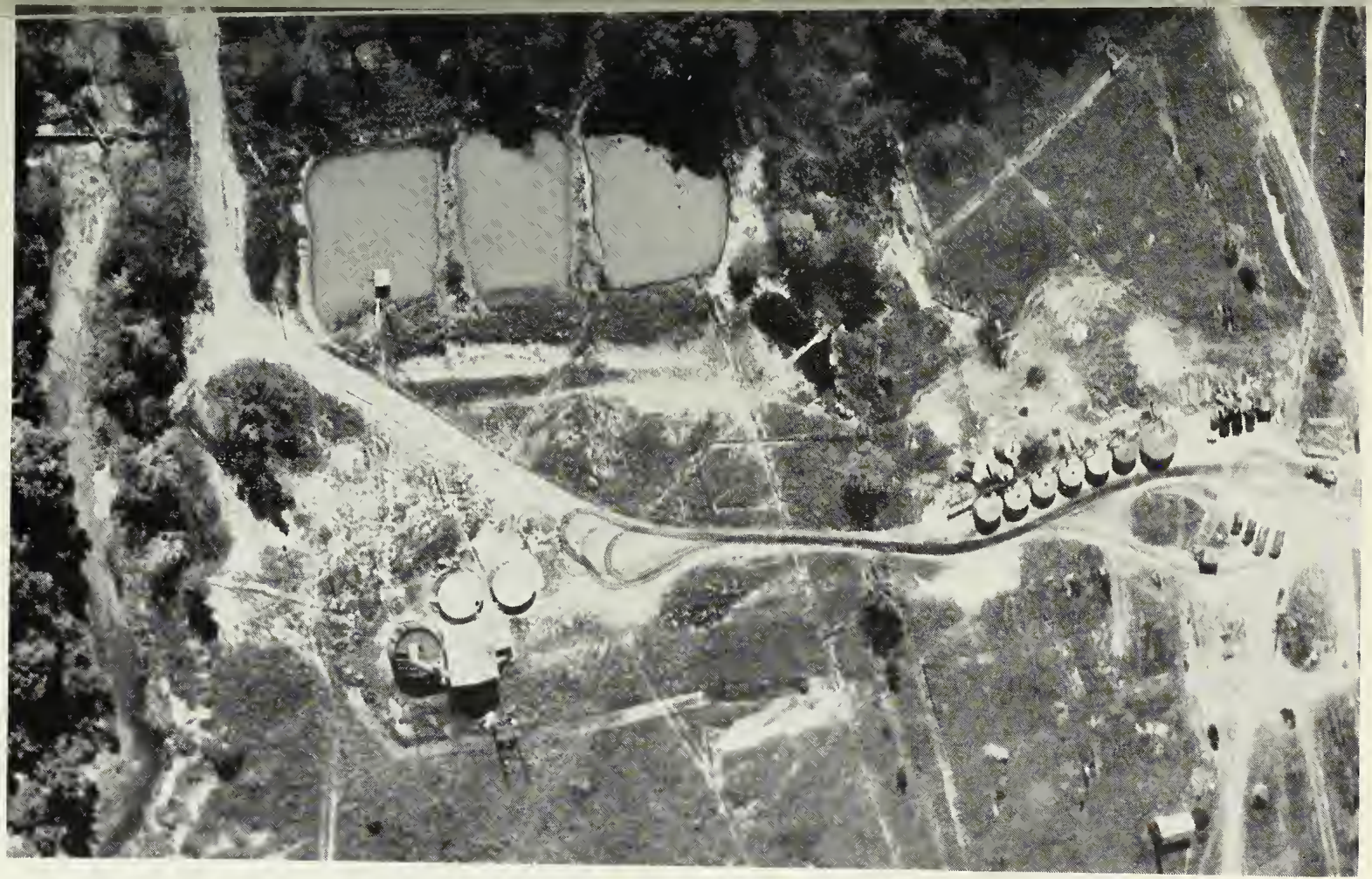
Drilling for oil in Illinois.

Oil and Gas

Illinois produced more than 64 million barrels of oil during the 12 months ending June 30, 1949, and continued to hold sixth place among the oil producing states of the nation. This continued high production has been achieved by the oil and gas industry largely through the discovery of new small pools, extensions to old pools, and new "pay sands" in old pools. From July 1, 1948 through June 30, 1949, 23 new pools, 62 extensions, and 24 new "pay sands" in pools were discovered.

9) *Aiding the discovery of new oil resources* is one of the primary functions of the Geological Survey's Oil and Gas Division. This is accomplished through the preparation of special maps and reports based on the scientific interpretation of well records, electric logs, drilling-time logs, and the microscopic examination of drill cuttings. Such maps and reports guide operators in their search for new oil pools and assist land owners in evaluating their properties.

10) *Fundamental geologic studies of oil-producing zones* are continually in progress in order to increase and clarify existing knowledge of their physical characteristics, their position in the geologic succession of strata and their relationships. With the natural falling-off of dis-



Airplane view of flooding operation at Siggins field. Brine from the producing wells is purified in the three ponds, further purified by filtering, and pumped to input wells throughout the field where it flushes out additional oil not otherwise recoverable. Such flooding operations have already produced 25 million dollars worth of oil at Siggins, Patoka, and from the basin McClosky.

coveries of new major oil pools, such "facies" studies become increasingly important to the discovery of new pay zones.

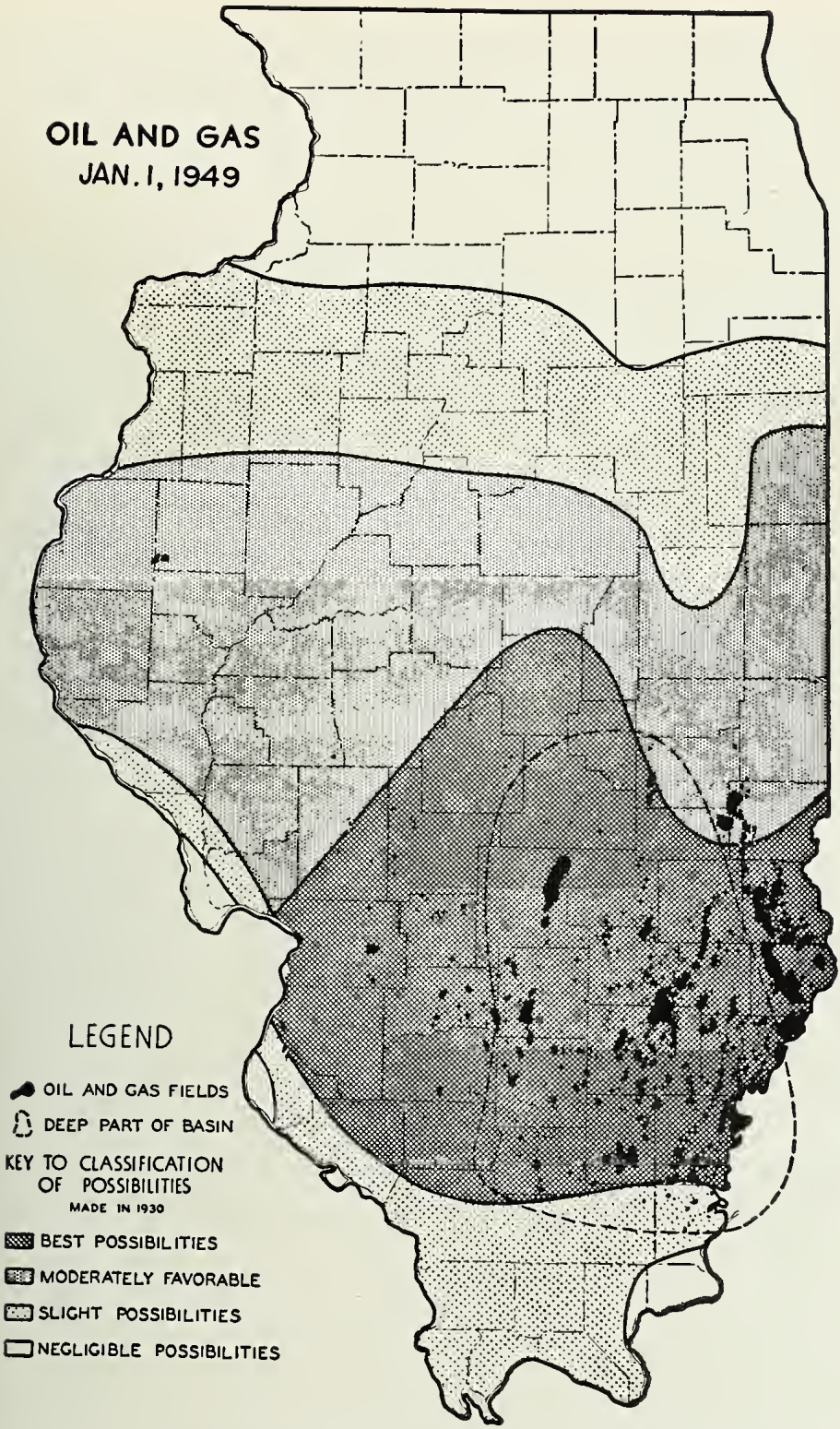
11) *Fossil coral reefs* have been discovered to be likely places of accumulation for oil and gas. A report on the distribution of coral reefs in the Niagaran limestone has been prepared and is now in press.

12) *The secondary recovery of oil* becomes increasingly important as natural primary production falls off and the probabilities of new major discoveries decrease. One method, introduced in Illinois largely as a result of Geological Survey studies, is that of water-flooding whereby that part of the oil remaining in a "sand" (after natural flow and pump production have waned) is flushed out of the reservoir rock by water pumped into the sand through an input well. By July 1, 1949, an estimated 12 million barrels of oil had been added to the State's production by this method since it was initiated in 1943.

The Geological Survey is continuing its studies of secondary recovery conditions through geologic studies of oil reservoirs, permeability of oil sands, analysis of brines, taking of gas-flow measurements, analysis of gas samples, and other determinations. A comprehensive report on "Illinois Oil Production by Fluid Injection" is being prepared.

13) *Monthly drilling reports* tabulating drilling activity throughout the State have been issued. Forty-four development maps of oil-producing areas, each three townships square and showing the results

Survey geologists making an electric log of a well at Siggins, to make possible a more accurate interpretation of the driller's log.



Map classifying oil and gas possibilities in Illinois, showing producing areas as of January 1, 1949. (Classification of areas made in 1930 by Alfred H. Bell.)

of drilling operation, are revised at 3-month intervals and available at nominal cost.

14) *An annual report* on oil and gas production in Illinois in 1948 was prepared. Such annual reports have been made without interruption since 1936 and constitute for prospectors and others a very complete record of oil well drilling and pool discoveries in the State over that period.

15) *Furnishing information,* much of it without cost, on oil and gas resources and development is one of the Survey's major activities. During the past year more than 500 persons visited the Survey offices for conferences on oil and gas problems, more than one thousand letters were written in response to inquiries regarding oil and gas producing possibilities, and there was a constant flow of loan copies of driller's logs from the Survey's files.

Clays and Clay Products

Clays and clay products produced in Illinois in 1948 were valued at more than 43 million dollars. Although clay is not commonly thought of as a particularly valuable material, it is one of the more important industrial minerals. Structural clay products had a value in 1948 of $17,200,539; refractories $8,281,469; and whiteware and pottery $17,924,175. Approximately 10 per cent of the brick output of the nation is produced in Illinois.

Illinois is an important producer of raw clay, including fuller's earth, kaolin, fire-clay, and surface clay. In 1948 clays which were sold and shipped as such, amounted to 261,205 tons, valued at the mines or pits at $1,293,385.

16) *Fundamental research of great value to the clay industry* is carried on in the Survey's laboratories. Mineralogic and x-ray studies have revealed that clays are commonly made up of a variety of clay minerals, the dominance of any one exerting a strong influence on the properties of the clay in accord with the molecular structure of the clay mineral.

Slight variations in the content of the clay in a pit may lead to increased costs of processing or burning or unsatisfactory products. Determination by the Survey of the precise mineral and textural content of raw clay has made possible, on many occasions, the identification of the offending material, enabling the manufacturer to devise the necessary technology to correct or circumvent the trouble, and has also revealed new uses not previously recognized.

17) *Systematic inventorying of the clay and shale resources* of this State is in constant progress. Field investigation and sampling of deposits, followed by laboratory analyses, continue to increase the wealth of information in the Survey's files and enable the Survey to guide operators and manufacturers to deposits of clays having the special properties needed to meet industrial specifications.

18) *The strength and stability of earth materials* is in many places strongly affected by the clay mineral content. During the year, mineralogical and textural analyses of some 20 soils were made and two

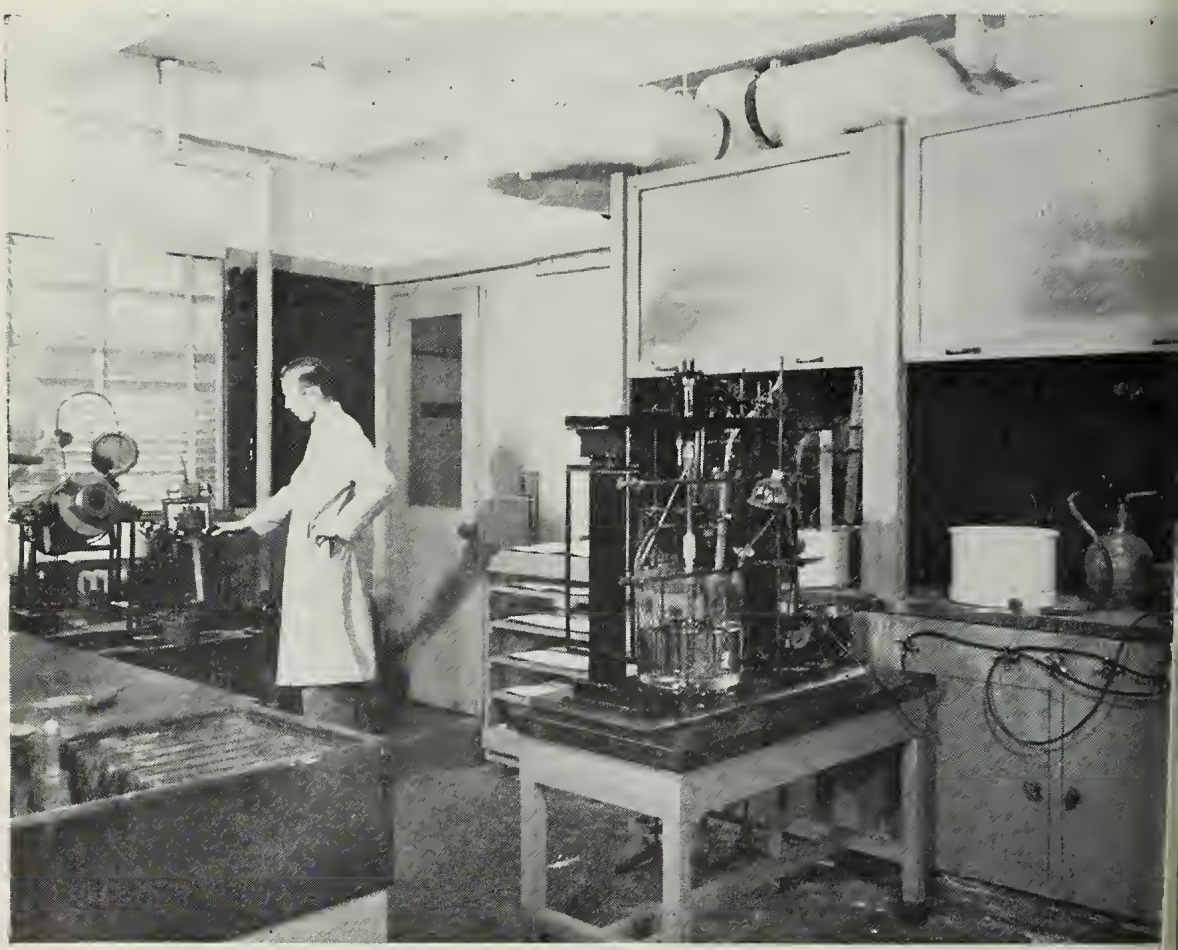
Airplane view of Illinois Clay Products plant in northern Illinois.

papers dealing with various aspects of this problem have been prepared for publication.

19) *World-wide recognition* has been given to the Illinois Survey's clay research program. Research workers in foreign countries, where war seriously impeded progress and where every effort has recently been made to reorganize and rehabilitate research laboratories, have turned to the Illinois Survey for information on new developments and new technology in this important field.

Rock and Rock Products

The value of rock and rock products produced in Illinois in 1948 amounted to more than 47 million dollars. The principal commercial stones produced and marketed in Illinois are agricultural limestone (agstone), crushed stone for road metal, concrete and paving, and metallurgical flux. Other important uses are for railroad ballast, rip-rap, whiting, filler, and chemical uses.



A laboratory of the Geological Survey for special research on fluorine and compounds. The Survey has fully equipped laboratories for the many aspects of mineral research.

20) *Furnishing information on potential quarry sites* is another of the very practical services which the Survey renders to industry. Only in the Survey's files can be found the detailed analytical information necessary to the location of deposits possessed of properties which will meet industrial specifications for particular uses, and operator and land owner alike benefit from this service.

21) *Illinois uses more agstone on its soils* than does any other state in the country, and the Geological Survey gives special attention to resources of limestone suitable for agricultural use. Samples submitted by land owners are analyzed by the Survey free of charge.

22) *Limestone resources of western Illinois* have been the subject of special investigation by the Survey during the past year to discover whether commercial deposits of high calcium limestone exist in that part of the State north of the Quincy area and a high-purity limestone 10 to 20 feet thick was found in Henderson County.

23) *Underground mining of limestone* in areas of the State where outcrops of quarryable stone are not present has attracted the attention of the Illinois stone industry, and the Geological Survey has undertaken the task of indicating areas for prospecting and drilling. From subsurface information in its files, the Survey has been able to locate several such areas in Vermilion, Edgar, Cumberland, and Coles counties.

24) *Fundamental research on Illinois limestones and dolomites* has been undertaken during the past year to develop comprehensive information on the mineralogy, lithology, composition, and properties of limestones and dolomites in order, if possible, to develop more extended use of these rocks.

25) *The sand and gravel resources of the State* receive constant study to meet inquiries from materials companies, construction engineers, and foundries.

26) *A special report on the silica resources* of Illinois, essentially completed during the past year, will provide the silica industry with a better understanding of its raw materials, its products, their range of use, and their limitations.

27) *Chemical studies of silicate melts* are being made in the Survey's laboratories to develop basic information on viscosity and surface tension of industrial slags required to meet industrial problems in the manufacture of glass, porcelain, mineral wool, and other ceramic products or in metallurgical processes. Two reports of these investigations have been issued during the past year.

Fluorspar

In 1948, some 52 per cent of the nation's output of fluorspar came from southern Illinois. Although the largest single use of this mineral is as a flux in the steel industry, almost half, and the more valuable half, of the fluorspar produced in 1948 found its way to other markets, chiefly those of the highly diversified chemical industry where it is in growing demand for use in refrigerants and other fluorine compounds, and for enamels, glasses, etc.

28) *The discovery of additional deposits* of this strategic mineral is essential to meeting continued high demand. The Geological Survey actively cooperates with the industry and others interested through the study and interpretation of data secured from test drilling. During the past year the Survey provided the owners of an old mining property with a new and more accurate picture of geological conditions which enabled them to extend their operations and discover several hundred tons of additional ore. A comprehensive report on "The Geology of the Southern Illinois Fluorspar District" is nearing completion.

29) *More diversified use of Illinois "spar"* as a chemical raw material should result from special chemical studies in progress in the Survey's laboratories directed toward the discovery of new and improved syntheses of organic fluorine chemicals. The Survey's fluorine research laboratory is generally recognized as one of the finest in the country, and its specialists are frequently consulted on matters of domestic production, imports, new discoveries, and promising lines of research and development.

Zinc and Lead

The old zinc mining district of northwestern Illinois, which played so important a part in the development of the Middle West during the last century, has been experiencing a substantial revival. In 1943, to help meet the nation's war-time need for these important minerals, the State Geological Survey undertook intensive field work in this area. Results of the Survey's investigations gave added encouragement to mining companies and prospectors to re-enter the area. Millions of tons of additional zinc ore have been discovered and active production and milling is underway.

30) *A revised structure map,* based on field studies carried on during the summer of 1948 and on the study of some 1500 borings, has been placed on open file in the Survey's field office in Galena and in its main office in Urbana. The map shows four previously unknown structures, in one of which ore has since been found. The other three have not yet been drilled. Examination by Survey geologists of an old mine, once a rich zinc producer, which was recently unwatered, developed evidence of the probable presence of some half-million tons of minable zinc ore.

31) *Geophysical prospecting in northwestern Illinois* has been carried on by the Survey during the field seasons of 1948 and of 1949 to discover the practicability of such methods in the exploration for ore bodies. Data so far secured indicate that all three methods give considerable promise.

Groundwater Resources

Studies to enlarge our present fund of information on sources of water supply receive special attention. In serving this general need, the Geological Survey cooperates closely with the State Water Survey by handling geological problems and furnishing geological information.

32) *Special reports* are prepared on the geology of specific locations where water is needed. These reports tell the driller or land owner

Large glass sand quarry in Illinois.

what kind of rocks underlie his land, in which of them water is likely to occur, and at what depths they will be found. During the past year the Survey's geologists have prepared some 200 such reports, of which some 60 were for municipal supplies, nearly 100 for private supplies, 25 for industrial use, and 15 for public institutions.

33) *Groundwater clinics,* sponsored jointly by the Geological Survey, the Water Survey, the Sanitary Engineering Division of the Department of Public Health, and the Illinois Section of the American Waterworks Association, have been held in two different areas in the State during the past year and have made worth while contributions to local water supply problems and to public education.

34) *The location of water-bearing sands and gravels* to depths of 200 feet can generally be determined by earth-resistivity measurements. This technique applied to the finding of groundwater supplies in glacial deposits was pioneered by the Geological Survey some 17 years ago and has met with outstanding success. Such resistivity surveys are of value chiefly in locating fairly extensive gravel aquifers from which large yields may be expected, such as are needed for municipal supplies and large industrial plants. The Geological Survey makes these surveys without charge, requesting only that the municipality or industry furnish four helpers in the routine field work. During the past year 15 such surveys have been run. This type of assistance is greatly in demand, and because the work can only be done when the weather is open, the Survey's schedule for this work is always booked for months ahead.

35) *Aid is given to test drilling* in connection with groundwater development programs through the study by the Survey geologists of samples collected and by the making of mechanical analyses of materials encountered. During the year, samples from 53 holes were examined and reported upon, and mechanical analyses were made on samples from 48 wells.

36) *Cooperation with the Illinois Water Well Driller Association* has been continued, a member of the Survey staff serving as executive secretary of the Association. This cooperative effort is extended to promote the science and art of water development.

Engineering Geology

Many major engineering projects, especially those involving problems of highway construction, the selection of sites for dams and reservoirs, the stability of earth materials for foundations for large structure, etc., are affected to an important degree by geologic conditions. The Survey's Division of Engineering Geology cooperates with other State and with Federal agencies on problems of this type.

37) *Field and office conferences* are held with engineers and others relating to engineering problems. Where necessary, earth materials are sampled and studied and reports are prepared. During the year this type of cooperation was extended to the State Waterways Division relative to geologic conditions at dam sites across Fox River; to the State Division of Highways with regard to test borings at bridge sites, materials for highway fills, subgrade materials, sources of sand and gravel deposits,

etc.; to the State Water Survey on its projects near Litchfield and Vandalia; to the University of Illinois on its reservoir project at Allerton; to the City of Galesburg on its reservoir for municipal water supply; and to various other agencies with reference to test borings, drainage projects, community planning problems, etc.

38) *The development of lakes and reservoirs* by the State Department of Conservation has continued to receive extensive cooperation from the State Geological Survey. Pertinent topographic and geologic data are provided, preliminary reports prepared, field examinations made, and where necessary, test borings are examined and interpreted.

Basic Scientific Studies

Fundamental studies must be continually pursued in order to develop information necessary to solve specific problems. Basic research in geology, chemistry, and physics is in progress toward this end.

39) *Geologic formations buried deeply underground* can be studied only by the examination under the microscope of drill cuttings from deep wells. The Survey's Subsurface Geology Division devotes a major portion of its time to such work. During the past year more than 50,000 samples from over 1,000 wells, representing a drilling distance of more than 51 miles, have been examined and charted by trained geologists. From the accurate correlation of underground strata, made possible by these studies, cross-sections and structure maps are prepared which prove of great value in the search for mineral resources.

Geophysical prospecting. Especially equipped mobile laboratory for investigating geological conditions and deposits underground by the use of radio ground waves.

40) *The study of the surface geology* of certain areas is in progress every field season. A particularly complicated area in the vicinity of Oregon, Illinois, has been receiving special study, and the knowledge secured will make an important contribution to more accurate interpretation of the regional geology of northern Illinois in general and to the ore deposits of northwestern Illinois in particular.

41) *Fossils of plant and animal life* contained in the rock strata tell the story of the conditions that existed at the time the strata were formed and serve as index guides in the correlation of underground formations. Study of these ancient forms of life with respect to the rock formations containing them is therefore in constant progress.

42) *Spectrographic analysis* of rock and mineral samples discloses the presence of and identifies trace amounts of mineral substances in earth materials; such substances frequently have an important bearing on the properties and use of the materials. The Survey is adding to its spectrographic equipment, and these studies are being carried on under the direction of the Survey's physicist who is a specialist in this field.

Mineral Economics

The economic trends and competitive elements in mineral production, transportation, and marketing are critical factors in industrial development. Through the employment of a mineral economist with a

Quarrying "agstone" to enrich Illinois soils.

small staff of assistants to follow and analyze these problems, the Survey is in a position to furnish economic information desired by mineral operators, producers, manufacturers, and chambers of commerce throughout the State.

43) *A special study of southern Illinois* has been in progress for some time under the sponsorship of a committee composed of staff members from the University of Illinois and the State Scientific Surveys. A detailed report on the mineral industries of southern Illinois, accompanied by a series of maps, graphs, and tables, together with a treatment on the economy of southern Illinois, has been prepared and published.

44) *Multiple fuel needs of an industrial economy* was the subject of a special study made by the Survey and the title of a paper summarizing the findings which was published and widely circulated among the coal industry.

45) *Trends in railroad fuel* constituted the subject matter of another published report. The demand has virtually exhausted the original printing.

46) *The fluorspar industry* has received particular study, and a report was prepared on the economic aspects of the industry, summarizing the history of the industry in the United States, production, imports, exports, and tariffs, beneficiation of ores, domestic and foreign reserves, fluorine compounds now of industrial importance, etc.

47) *An annual statistical report* on the Illinois mineral industry in 1948 is being prepared for publication. This work is carried on in cooperation with the U. S. Bureau of Mines, the U. S. Bureau of the Census, and the State Department of Mines and Minerals. Similar annual reports, issued since 1931, constitute an uninterrupted series on Illinois' mineral industry since that date.

Topographic Mapping

48) *A systematic program of topographic mapping* is carried forward in the State each year, in cooperation with the U. S. Geological Survey. The ultimate goal is to cover the entire State with a map of this type and accuracy. Through the progressive attitude of Illinois legislators in regularly appropriating funds to carry on this work, which funds are matched dollar-for-dollar by the Federal Government, our State is now nearly 90 per cent mapped. It is hoped to complete the mapping of the State in the next decade. During the past year 842 square miles of territory were mapped topographically on a scale of 1 inch to a mile; 529 square miles were mapped on a scale of 2½ inches to a mile; and 95 square miles of Multiplex contouring were completed in the field.

Public Service and Educational Extension

49) *Public information.* The Geological Survey functions as a public information bureau on matters relating to mineral resources, their occurrence, distribution, and development. No inquiry received is too unimportant to be answered promptly and thoroughly. Through conferences and correspondence the Survey stands ready to assist in the

development and conservation of the State's mineral resources and to serve the State's citizens.

50) *Educational extension.* A special division of the Geological Survey renders educational extension service which includes: Free identification of mineral specimens, informative correspondence with teachers, pupils, and individuals, free lectures to organized groups, the publication of popular educational pamphlets, and exhibits at State and County fairs and professional meetings.

During the past year 489 sets of rock and mineral specimens with printed labels and study manuals were distributed free of charge except for mailing costs to schools and nature study groups through the State. Field conferences, primarily for high school science teachers but open to any interested person, were conducted near Danville, Apple River Canyon, Moline-Rock Island, Pekin, Cairo, Casey, and in Calhoun County.

Publications

Prompt publication of results obtained from research work is essential to its greatest effectiveness and every effort is made to achieve this.

The Geological Survey's Applied Research Laboratory where semi-plant-scale experiments work toward improved products from Illinois mineral resources.

Three maps, including one showing the shipping coal mines in Illinois, an oil and gas map of the State, and a map of the pre-glacial drainage lines were issued. Thirty-eight publications were printed and distributed, bearing on various phases of coal, oil and gas, clay and clay minerals, fluorspar, agstone, synthetic liquid fuels, the State's mineral production, and other subjects. A complete list of the Survey's publications is available free upon request.

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